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LIFE HISTORY OF *STOLAS* (*ANACASSIS*) *FUSCATA* (KLUG) (COLEOPTERA: CHRYSOMELIDAE) ON SEEPWILLOW, *BACCHARIS SALICIFOLIA* (R.&P.) PERS. (ASTERACEAE)

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Abstract.—The leaf-feeding chrysomelid *Stolas* (*Anacassis*) *fuscata* (Klug) is a dominant herbivore of the woody shrub seepwillow, *Baccharis salicifolia* in central and northern Argentina. In Buenos Aires Province, it also occurs on *Baccharis punctulata* DC. The life history of this leaf-feeder was studied in the field in Argentina and in the laboratory in the United States. In central Argentina, there were three generations per year. Eggs were deposited in clusters about 1.2 m above the ground on the uppersides of leaves. There were 8 to 55 eggs per cluster of which 90% hatched in seven days. Eggs were held together with a viscous-like secretion that dries on exposure to air. In the laboratory, development from egg to adult eclosion took 36 to 46 days. Five larval instars developed in 27 days and consumed 79.6 cm^2 of leaf material. Pupation occurred on the plant and adults emerged in 6.6 days. Females laid an average of 1614 eggs, lived an average of 27 weeks, and consumed 221 cm^2 of leaf. The eulophid *Emersonella saturata* De Santis (or near) was reared from eggs of *S. fuscata* and the tachinid *Eucelatoriopsis parkeri* Sabrosky was reared from larvae, pupae, and adults.

Key Words: Insecta, Coleoptera, Chrysomelidae, *Stolas* (*Anacassis*) *fuscata,* Asteraceae, *Baccharis,* seepwillow, biological control, life-history

Seepwillow, *Baccharis salicifolia* (R.&P.) Pers. (*glutinosa* Pers.) (Asteraceae: Baccharidinae), is an undesirable, perennial, woody shrub that has little or no value to agriculture. It commonly grows along streams and canals, restricts water flow, and causes sediment deposition (Gatewood et al. 1950, Brady et al. 1985, Boldt 1989a). This shrub is distributed from the southwestern United States to northern Mexico and from Colombia to Argentina (Cuatrecasas 1968, Nesom 1988).

Nine leaf-feeding beetles of the genus *Stolas* Bilberg (*Anacassis* Spaeth) occur in South America and generally feed on plants of the subtribe Baccharidinae, primarily *Baccharis* (Boldt 1989a). *Stolas fuscata* (Klug) occurs in Argentina, Brazil, Paraguay (Blackwelder 1946), and Uruguay (Silveira-Guido and Ruffinelli 1956). Adults are distinguished by Boheman (1850) as pale yellow in color, with the presence of two longitudinal brown stripes on the punctate elytra and a brown spot on the prothorax; four color variations are mentioned. The body is oval and 9 to 10.5 mm long. A taxonomic description of the five larval stages, measurements of eggs and larvae, and notes on the life history of *S. fuscata* in Brazil are given by Buzzi (1975).

Five species of Stolas were evaluated by McFadyen (1979, 1987) as potential bio-

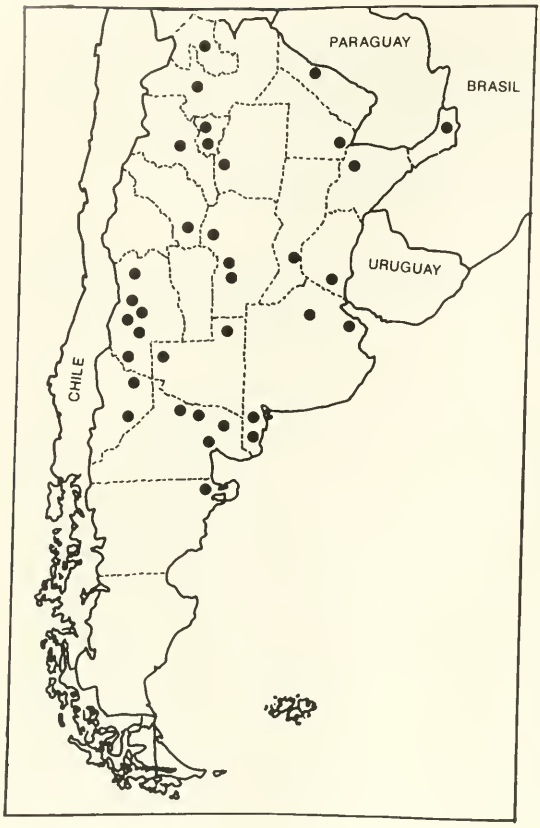

Fig. 1. Distribution of *Stolas fuscata* in Argentina.

logical control agents of *Baccharis halimifolia* L. in Australia. Larvae and adults of *S. fuscata* feed on seepwillow and *Baccharis pingraea* (A.P.) DC. in Argentina but feed on *Baccharidastrum triplinerve* (Lessing) (Asteraceae) and occasionally on *Baccharis gaudichaudiana* DC. in Brazil. This leaf-feeder was found to be host specific and was introduced into Australia, near Brisbane, as a potential biological control agent. After three years, however, the population had not established and apparently died out (McFadyen 1987).

We collected and studied this leaf feeder as part of an evaluation of phytophagous insects in South America for the control of weedy baccharis shrubs in the United States. The cerambycid *Megacyllene mellyi* (Chevrolat) from Argentina and Brazil was tested for host specificity on *B. halimifolia* but rejected because it feeds on an important landscape shrub *Baccharis pilularis* DC. (Boldt 1987). *Stolas fuscata* is host specific to seepwillow and could be released in the United States as a biological control agent (Boldt 1989b). In this report, we discuss the biology of *S. fuscata* in Argentina and laboratory studies that were conducted in Argentina and the United States.

Materials and Methods

Field observations.—The geographic distribution of *S. fuscata* in South America was determined from field collections, labeled specimens in museums in Argentina, and literature records. Observations of the life-cycle were made on seepwillow near Realicó (La Pampa Province) and Buenos Aires (Buenos Aires Province), Argentina, from 1986 to 1987. Egg clusters werre sampled at Arroyito (Neuquén Province) and Realicó in October, 1986, and at Medanos (Buenos Aires Province), Realicó, and Río Cuarto (Córdoba Province) in January 1990. At each site, egg clusters were selected without bias and number of eggs, larval emergence, and egg parasitism was recorded. In 1990, the height above ground and location on the leaf was also measured for each egg cluster. Location on the leaf was determined by visually dividing the leaf into four sections with three lines perpendicular to the midvein and recording the quadrant in which it occurred.

Laboratory studies.—Adults were collected and studied at the Biological Control of Weeds Laboratory, Hurlingham (Buenos Aires Province), Argentina from 1986 to 1988. Other adults were air-freighted to quarantine at Temple, Texas, for host range tests and biology studies. The laboratory at Temple was maintained at a temperature of 22 to 26°C, relative humidity of 40 to 60%, and photoperiod of 12 h light and 12 h dark. A laboratory colony was maintained on excised leaves of potted seepwillow or leaves

periodically collected in the field near Laredo, Texas.

The number of larval instars was determined by collecting 0- to 24-h-old larvae as they emerged from eggs in the laboratory and rearing them through successive instars. About 25 larvae in each instar were preserved in 70% ethanol. Headcapsule widths were measured with a calibrated ocular micrometer on a stereomicroscope.

Oviposition characteristics were recorded from observations of pairs of 5- to 7-d-old copulating adults held in separate petri dishes (dia. = 11 cm) with freshly excised leaves of seepwillow. The leaves were replaced 3 times weekly. Leaf consumption was determined by placing a 1-mm^2 plastic grid over the leaves and counting the consumed squares or with before and after estimates of area with a Li-Cor Model Li 3000 leaf area meter (Li-Cor, Lincoln, Nebraska). Laboratory bench tops, shelves, and equipment were cleaned with a 10% Chlorox solution before and after feeding to reduce possible microbial contamination. Insect voucher specimens were deposited in the U.S. National Museum of Natural History, Washington, D.C.

Results and Discussion

Field observations.—In Argentina, the leaf-feeding *S. fuscata* was commonly present on seepwillow from the high altitude desert of northern Argentina, near Volcán (Jujuy Province) to the arid areas of Chubut Province in the south (Fig. 1). Beetle densities were highest in the arid or semiarid west-central provinces of Mendoza, Neuquén, and La Pampa. A few larvae and adults were collected on *Baccharis punctulata* DC. in Buenos Aires and Santa Fe Provinces where seepwillow is rare. Despite extensive searching, no individuals were found on *B. pingraea,* as reported for Argentina by McFadyen (1987).

We observed three generations of *S. fuscata* per year in central Argentina (Fig. 2) although only two generations occur in southern Brazil (Buzzi 1975). In Argentina, eggs of the first generation were laid in September and October by adults that survived the winter. Second generation eggs were laid in January and third generation eggs were laid in February and March. Adults of the third generation emerged in late April and May, fed briefly, and overwintered in the soil or plant debris from June to late September. Reappearance in the spring corresponded with the production of new leaves on seepwillow. Larvae from all generations overlapped and were continuously present in the field from late September to March. Teneral adults and some mature adults were pale yellow in color whereas most of the mature adults, especially those that overwintered, were dark yellow and often had two brown longitudinal stripes on the elytra and a brown spot on the prothorax. Legs and antennae were black. These light colored adults may have been misidentified as a different species, *Stolas* (*Physonota*) *unicolor* (Burmeister 1870), or subspecies, *S. fuscata unicolor* (Burmeister 1870) (McFayden 1987).

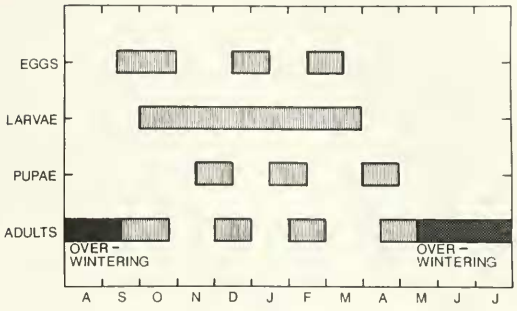

Fig. 2. Generalized life cycle of *Stolas fuscata* in central Argentina.

In October 1986, 76 first-generation egg clusters collected at Arroyito contained 19.7 ± 5.4 (mean ± standard deviation) (range = 8–37) eggs per cluster of which 88.0 ± 21.3% hatched. Ten percent of the eggs were parasitized. Eight egg clusters at Realicó contained 36.9 ± 11.9 (24–55) eggs per cluster of which 94.3 ± 13.1% hatched. In January 1990, a collection of 45 egg clusters

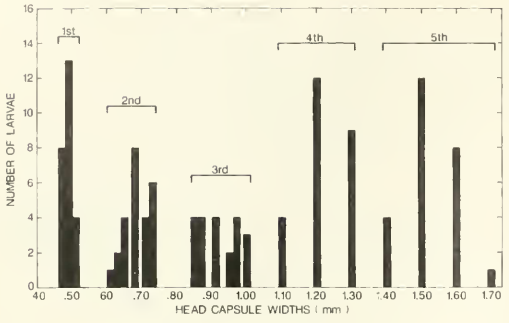

Fig. 3. Frequency distribution of head capsule widths (mm) of larvae of *Stolas fuscata* indicating larval instars.

contained 12.4 ± 4.4 eggs per cluster (range = 5–22). Ninety-six percent of these clusters were laid on the upper leaf surface. When the leaves were divided into four sections, 15.5, 53.3, 26.7, and 4.4 percent of the 55 clusters were present in the first, second, third, and fourth quadrants from the tip of the leaf, respectively. Despite the presence of apparently suitable leaves in all parts of the shrub, females laid most clusters of eggs in the top half, at a mean height of 1.2 ± 0.4 m (range = 0.5–2.2) above the ground. The highest egg clusters were usually found on the tallest plants.

First- to fourth-instar larvae fed in groups, usually on the upperleaf surface. Group size decreased as the larvae matured and fifth-instar larvae usually fed alone. First-instar larvae fed only on the surface layer of leaf tissue but fourth- and fifth-instar larvae consumed the entire leaf. Pupation most commonly occurred on the lower side of the leaf.

Laboratory studies.—*Egg:* Newly deposited eggs were oblong to elliptical, tapered on both ends, and yellow to tan in color; the chorion was hard and punctate. The eggs measured 1.75 ± 0.07 mm long × 0.78 ± 0.04 mm wide (n = 35). There were 17.1 ± 3.9 (n = 11) eggs per cluster but cluster size was highly variable (range = 3–25). Clusters and individual eggs were found on both sides of leaves and on the sides of the plastic cage. A clear, viscous fluid covered the surface of each new egg when laid and formed a 1 mm long stalk that held the egg above the surface of the leaf. This fluid quickly dried when exposed to the air. It lightly glued eggs in a cluster together and to their substrate. Egg hatch was 95.9 ± 0.1% (n = 9686) with a decrease in hatch occurring near the end of the females' lives. The incubation period was 7 ± 0.2 days (range = 6.5–7.5) (n = 183). All eggs of the same egg cluster usually hatched within a few hours.

Larvae: Observations of larval development and the frequency of distribution of head capsule measurements indicated five larval instars. The mean and standard deviation of widths were: 0.48 ± 0.02, 0.69 ± 0.03, 0.92 ± 0.05, 1.25 ± 0.09, and 1.53 ± 0.8 mm (n = 25 larva per instar) for the first- to fifth-instar, respectively (Fig. 3). Egg and larval measurements were similar to those reported by Buzzi (1975).

Neonate larvae emerged head first from a circular hole chewed in the chorion at the tip of the egg. As also observed in the field, young larvae fed gregariously, with those of a similar size usually clustered together. First-instar larvae fed only on one surface of the leaf leaving the other intact while fourth- and fifth-instar larvae consumed both sides, often creating a hole in the leaf where they fed. Individual larvae consumed 1.8 ± 0.4, 3.1 ± 0.6, 5.6 ± 1.9, 14.8 ± 5.4, and 54.3 ± 15.8 cm^2 of seepwillow leaf area (n = 18) in the first through fifth stages, respectively. Total leaf consumption was 79.6 ± 17.9 cm^2 per larva of which 68.2% occurred in the fifth instar. Each instar fed for 5.7 ± 1.8, 6.8 ± 1.7, 3.7 ± 0.6, 3.7 ± 0.6 and 7.2 ± 0.7 days, respectively, for a total of 27 ± 2.1 days. Like other members of the Cassidinae, larvae of *S. fuscata* carried exuviae and feces dorsally on the anal fork.

Pupae: The newly formed pupae were initially yellow in color but darkened with age. Pupae were attached to the leaf at the apex of the abdomen and often flexed their bodies when disturbed. Female pupae weighed

6.2 ± 1.3 mg (n = 9) and male pupae weighed 4.5 ± 0.1 mg (n = 9). Pupae were held for 6.6 ± 0.7 days (n = 17) before emergence as adults. If the minimum and maximum times for each stage from egg to pupae are summed, development to adult should take 36.5 to 46 days.

Adults: Locomotory movement of the adults was slow. Females mated several times during their lives; the first mating occurred 3–5 days after emergence and others occurred at irregular intervals. Oviposition began about 1 week after initial mating and continued up to 26 weeks (Fig. 4). The mean fecundity for 6 females was 1614 ± 444 (range = 1152–2247) eggs per female; 50% of the eggs were laid within the first 13 weeks. This is higher than the 325 eggs per female reported by Boldt (1989b) but may be due to the use of seepwillow leaves from field plants rather than potted ones. Females lived 146 ± 32 days after emergence and consumed 296.9 ± 103.3 cm^2 of leaf while males lived 128 ± 33 days after emergence and consumed 221.6 ± 51.9 cm^2 of leaf (n = 6).

Mortality factors.—In Argentina, we commonly reared the tachinid *Eucelatoria parkeri* Sabrosky from field-collected larvae, pupae, and adults of *S. fuscata* throughout the summer. This parasitoid also was recorded from fifth instar field-collected larvae in southern Brazil and Uruguay by Buzzi (1975). We reared an eulophid, *Emersonella* (*Testudicida*) *saturata* De Santis (or near), from eggs. This parasitoid was previously recorded only from *Stolas prolixa* (Boheman) (De Santis 1983). McFadyen (1979) reared the eulophid *Emersonella niveipes* Girault (*nigricoxae* De Santis) from eggs and found mites (Canestriniidae) on the ventral surface of adults of *S. fuscata.* Near Buenos Aires, we observed the pentatomid *Stiretrus decastigmata* Herr. Schaf., and the ant, probably *Solenopsis richteri* Forel, feeding on small and medium-sized larvae of *S. fuscata.* Ant predation also occurred in eastern Argentina.

The life history of *Stolas fuscata* indicates

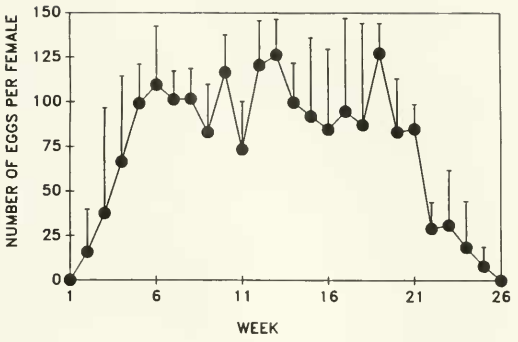

Fig. 4. Mean weekly oviposition of females of *Stolas fuscata* from first mating.

that it is a good candidate for the biological control of seepwillow because it is multivoltine, feeds on seepwillow or *B. pingreae,* a shrub that does not occur in the United States, and is capable of consuming large amounts of leaves. Females are long lived and may lay over 1600 eggs. Both adults and larvae are monophagous on seepwillow (McFadyen 1987, Boldt 1989b). The release of this leaf-feeder in the United States could result in a reduction of seepwillow density without its elimination.

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